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CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 14 November 2002 with an application for Letters Patent number 522596 made by DAVID ARTHUR LEE.

Dated 25 November 2003.

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522596

NEW ZEALAND

PATENTS ACT, 1953

PROVISIONAL SPECIFICATION

APPARATUS FOR PRODUCING A YARN

We, **DAVID ARTHUR LEE**, a New Zealand citizen, of 177 Maces Road, Christchurch, New Zealand, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement.

FIELD

The invention comprises apparatus for producing a yarn, which is adapted to be able to vary the degree of twist in the yarn or the twist profile of the yarn.

BACKGROUND

In producing a wool yarn, or a yarn which is formed predominantly of wool, a number of wool slivers may, typically after drafting, be passed through a twisting stage which comprises reciprocating rotating rollers which move from side to side as the wool slivers pass between the rollers, thereby imparting a twist to the strands. After exiting the twist rollers, the strands are brought together to twist naturally with each other to form a multi-ply yarn.

New Zealand patent 336048 discloses a method for producing a yarn comprising three or more slivers, or ends, in which the three slivers are passed between reciprocating twist rollers and then one or more of the slivers is passed over a path of a different length before the slivers are brought together. Rather than all of the slivers or ends passing through the twisting stage together and then being twisted naturally together, the twist in one or more of the slivers or ends is staggered or out of phase relative to the twist in the other slivers.

SUMMARY OF INVENTION

The present invention provides an improved or at least alternative apparatus for producing a yarn comprising a plurality of twisted strands.

In one aspect the invention broadly comprises apparatus for producing a yarn including a reciprocating twisting stage adapted to simultaneously twist one or more slivers to produce one or more twisted strands, including one or more rollers arranged to move reciprocally along the axis of rotation of the roller(s) to impart twist to the sliver(s), and control means enabling control and variation of the rotational speed of the one or more rollers to vary the twist imparted to the slivers or strands.

Preferably the speed of transverse movement of one or more rollers may also be varied to achieve a desired degree of twist in the strands of the yarn.

In another aspect the invention broadly comprises apparatus for producing a yarn including a reciprocating twisting stage adapted to simultaneously twist one more slivers to produce one or more twisted strands, including one or more rollers arranged to move reciprocally along the axis of rotation of the roller(s) to impart twist to the sliver(s), and so mounted that the extent of the transverse reciprocating movement, or throw, of the roller(s) can be varied to vary the twist imparted to the sliver(s) or strands.

In another aspect the invention broadly comprises apparatus for producing a yarn including a reciprocating twisting stage adapted to simultaneously twist one more slivers to produce one or more twisted strands, including one or more rollers arranged to move reciprocally along the axis of rotation of the roller(s) to impart twist to the sliver(s), and control means enabling controland variation of the speed of the transverse reciprocating movement, or throw, of the roller(s) speed to vary the twist imparted to the sliver(s) or strands.

Preferably any one or more of the transverse speed, the extent of the transverse movement or throw, and the rotational speed of the one or more rollers can be varied to achieve the desired degree of twist or twist profile in the strands of the yarn.

Preferably the apparatus includes an associated control system including a microprocessor, PLC, or similar which controls the transverse movement or throw, and/or the speed of transverse movement, and/or the rotational speed of the one or more rollers and/or which enables a user to programme the degree of twist or twist profile to be imparted to a production run, series of production runs, or part run.

In a further aspect the invention broadly comprises apparatus for producing a yarn including a reciprocating twisting stage including one or more rollers adapted to simultaneously twist a plurality of slivers to produce a plurality of twisted strands, one or more guides positioned such that one or more of the strands passes over a longer path than

one or more other strands before the strands are brought together to form a multi-ply yarn and a guide reposition system for varying the position of one or more guides between or during a production run. Typically the guide reposition system includes an electro-mechanical guide adjustment mechanism for moving one or more guides, controlled by a microprocessor-based or similar control system.

BRIEF DESCRIPTION OF THE DRAWINGS

Forms of apparatus of the invention are described with reference to the accompanying drawings by way of example and without intending to be limiting, wherein:

Figures 1A is a view of a length of one example of yarn which may produced by the apparatus of the invention, and Figure 1B schematically shows relative positions of the twisted areas in each strand making up the yarn,

Figure 2 schematically shows one form of apparatus of the invention from above,

Figure 3 shows the apparatus from one side, showing the drafting unit and twisting rollers thereof,

Figure 4 shows the strands exiting the twisting rollers being brought together by guides, and

Figure 5 schematically shows one system for driving the twist rollers.

DETAILED DESCRIPTION OF PREFERRED FORM

Referring to Figure 2 the preferred form apparatus comprises a drafting unit 5 comprising opposed moving preferably rubber coated rollers or belts, between which the fibres pass (as slivers). In the example shown, three slivers (unspun) of for example wool drawn from drums or other bulk supply (not shown), are fed between rollers 4 and through the drafting unit 5 and are drawn out - typically the thickness of the wool fibre assembly is reduced to

between one half to one twenty-fifth of the initial thickness. The amount of thickness reduction may be adjusted by altering the rotational speed of the drafting unit.

A reciprocating twisting stage 6 comprises a pair of rollers 6a and 6b (see Figs 3 and 4), one or both of which rotate as well as reciprocate back and forth across the direction of movement of the strands as the apparatus operates. The twist rollers 6 impart twist in one direction as the roller(s) move(s) one way followed by twist in another direction as the roller(s) move(s) the other way in operation. In addition, areas of non-twist may be formed in the strands at the point at which the roller(s) change(s) direction. Alternatively a single reciprocating roller may move relative to a flat surface over which the strands pass, to twist the strands between the roller and surface.

The extent of the transverse reciprocating movement or throw of the roller 6a and 6b may be varied to achieve the desired degree of twist in the strands or twist profile of the yarn, as will be further described with reference to Figure 7. Additionally or alternatively the desired degree of twist may be obtained by varying the rotational speed of the twist rollers 6a and 6b. Additionally or alternatively again the degree of twist or twist profile may be varied by adjusting the speed of reciprocating the transverse movement of the twist roller(s) (relative to their rotational speed). The variation in the speed of transverse movement and/or throw and/or rotational speed of the twist roller(s) may be controlled by a microprocessor-based control system. A user may programme roller speed, the extent of roller transverse movement, and the rate of roller transverse movement, for any production run to achieve a desired twist profile in the strands or resulting multi-ply yarns.

Referring to Figure 7, in the arrangement shown electric motors 7a and 7b drive rotation of the twist rollers 6a and 6b. The rotational speed of rollers 6a and 6b may be varied by varying the speed of the electric motors 7a and 7b, to vary the degree of twist in the strands of the yarn. The speed of the roller drive motors may be constant for a production run or may be controlled by a user programmed microprocessor to vary during a production run, or over a series of production runs.

Electric motor 9 such as a servomotor drives the reciprocal movement of the twist rollers 6a and 6b, and maybe controlled to vary the extent of reciprocal transverse movement or the throw of the twist rollers. Servomotor 9 or gear drives a pulley or sprocket (not shown) which rotates and counter rotates and is connected to cable or chain 14 which extends about pulley or gear 13. Cable or chain 15 also extends about pulley or gear 13 and is connected at one end to shaft 16a and at the other end to shaft 16b, via swivels or similar. Rotation and then counter rotation of the output of the motor 9 drives the cable 15 and thus the twist rollers 6a and 6b back and forth with a reciprocal movement. That is, movement of cable or chain 14 in an anti-clockwise direction by servomotor 9 will cause cable or chain 15 to move in an anti-clockwise direction and roller 6a to move in the transverse direction shown in Figure 7 and roller 6b to move in the opposite direction, as shown, and vice versa when servomotor 9 reverses its direction. The twist roller shafts 8a and 8b attach to cable or chain 11 at their other ends, which passes about pulley or gear 12, via swivels or similar. The extent of the lateral movement or throw of the rollers correlates to the degree of twist in the strands of the yarn, i.e. a greater lateral movement of the rollers will result in a higher degree of twist in the strands (for a given roller rotation and speed), and vice versa.

The rollers 6a and 6b maybe mounted for rotational movement and reciprocating side movement by the roller shafts 8a and 8b passing through slide bearings 10 on one or both sides (shown on one side only – the right hand side of Fig 7) or similar. The roller shafts 8a and 8b may pass slidingly through electric motors 7a and 7b which drive the rollers while also allowing for the sideways reciprocal movement of the rollers/roller drive shafts.

Variation in the throw and/or rotational speed of the twist rollers may be achieved without the use of servomotors by using other suitable equivalent mechanical or electro-mechanical means without departing from the scope of the invention.

Referring to Figure 4 following the reciprocating twisting stage, to produce one form of yarn one or more of the strands is led directly through primary guide or eyelet 1b, while the other strands are led through secondary guides or eyelets before also passing through primary guide 1b, so that some strands have a different path length before entering primary guide 1b. Strand 2 passes through guide 2b whilst strand 3 passes through guide 3b before both passing

through primary guide 1b. As the strands exit the eyelet 1b they tend to self-twist together, or alternatively, a further twisting mechanism may optionally be provided to assist in twisting the three (or more) strands together to form the finished yarn. Such a further twisting mechanism may be controlled to enable the extent to which the individual strands are twisted together to be varied ie to enable control of the "twist within the twist" of the yarn. Each of the strands passes over a path of different length relative to the other strands, so that the areas of twist in each of the strands are staggered, or out of phase, relative to one another. In this form of yarn the different path lengths are such that the areas of non-twist in each strand are overlaid with areas of twist in other strands in the finished yarn. The resulting yarn is schematically shown in Figures 1A and B. Referring to Figures 1A and 1B, the yarn example illustrated comprises three twisted strands which are loosely twisted together to form the finished yarn. Each of the strands 1, 2, and 3 are "staggered", or out of phase, relative to each other, so that areas of non-twist 1a, 2a, and 3a in each of the strands of the yarn are overlaid by areas of twist in the other strands, as shown. Figure 1A exaggerates this for clarity. In the finished yarn, the areas of non-twist in one strand are overlaid by areas of twist in the other strands. Figure 1B seeks to schematically illustrate this – in Figure 1B the three strands are shown parallel (before any twisting together) and in each strand the areas of twist (in alternate directions) formed by the twist roller(s) 6 are indicated in hard outline while the areas of non-twist between the areas of twist are indicated in broken outline, as indicated at 1a, 2a, and 3a, for example. Any area of non-twist in any strand, such as non-twist area 1a, is overlayed for at least part of its length by areas of twist in the other strands as shown.

In a further embodiment, the apparatus of the invention may be capable of adjusting the position of the guides or eyelets or their mechanical equivalent, which bring the individual strands together, to vary the point of overlap or relative phase of the strands. For example the guides 1b, 2b and 3b or equivalent may be mounted to a geared track carried by transverse mounting bar 10 in Figure 4, and each have a small associated electric motor which may be driven to move the guides, one or more at a time, along the mounting bar 10. The adjustment of the eyelets, or their equivalent, may be controlled by a microprocessor-based control system.

The foregoing describes the invention including a preferred form thereof. Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof.

DAVID ARTHUR LEE
By the authorised agents
A. J. PARK
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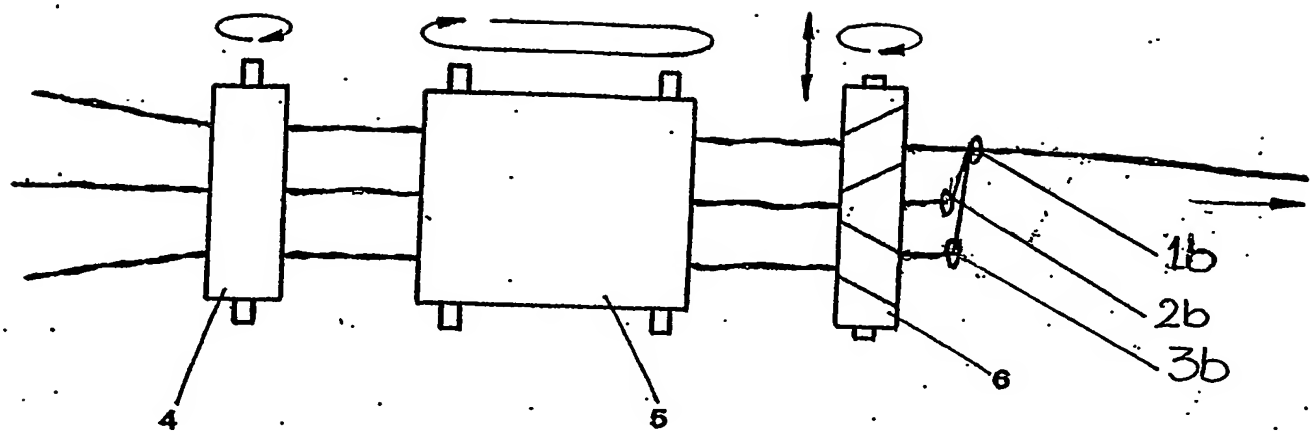

Figure 2

Figure 1A

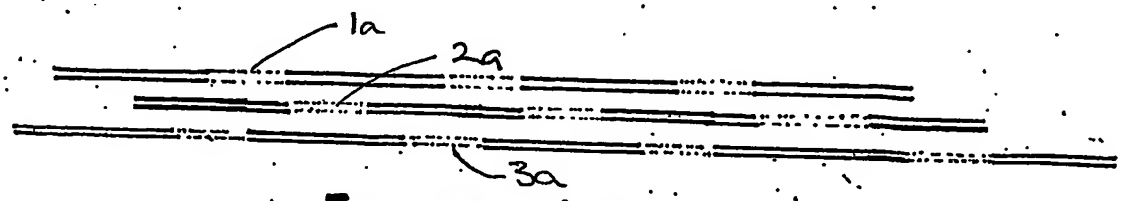

FIGURE 1B

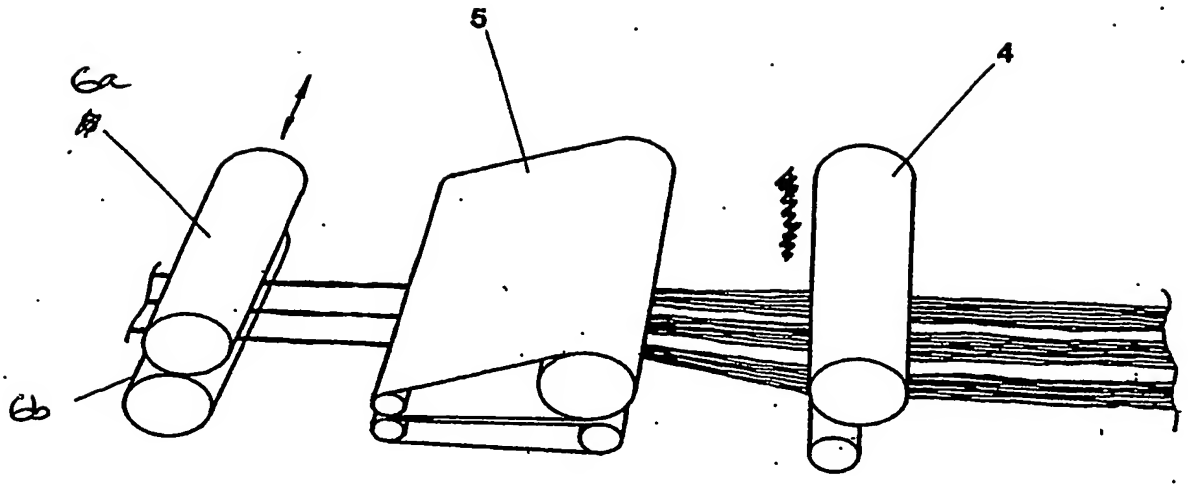

Figure 3

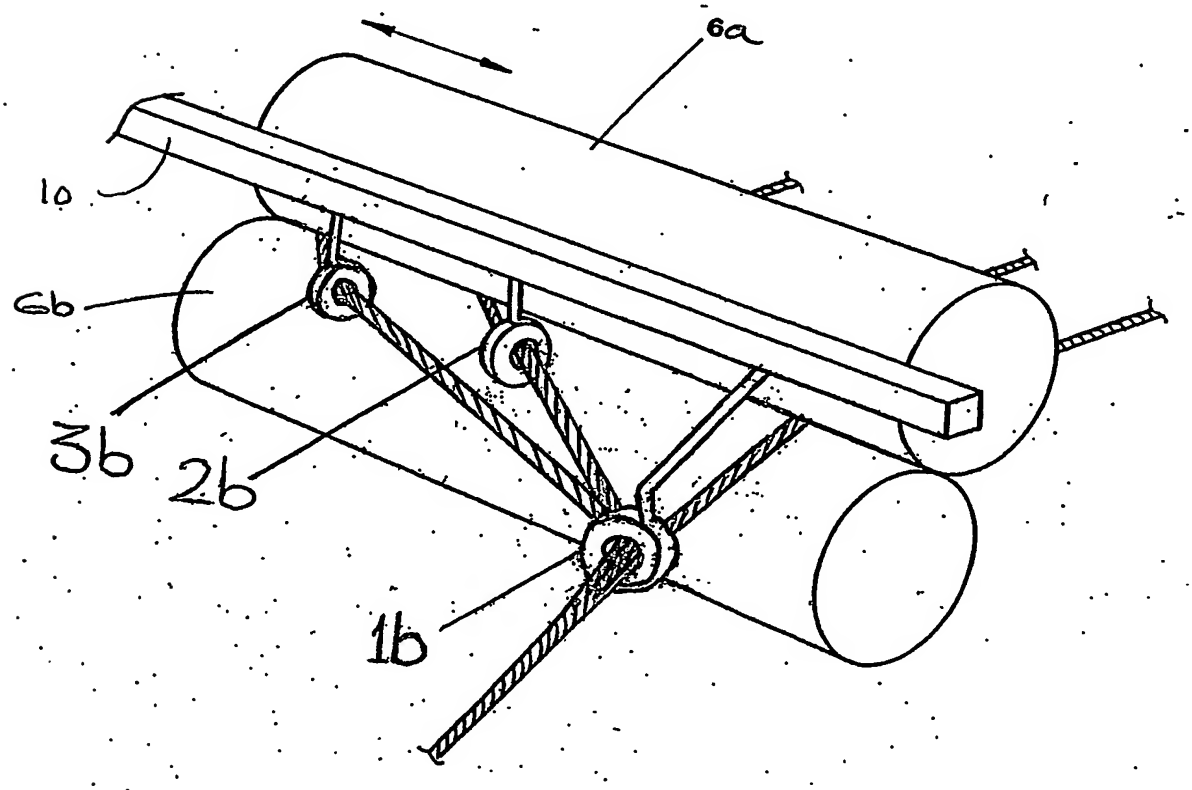

Figure 4

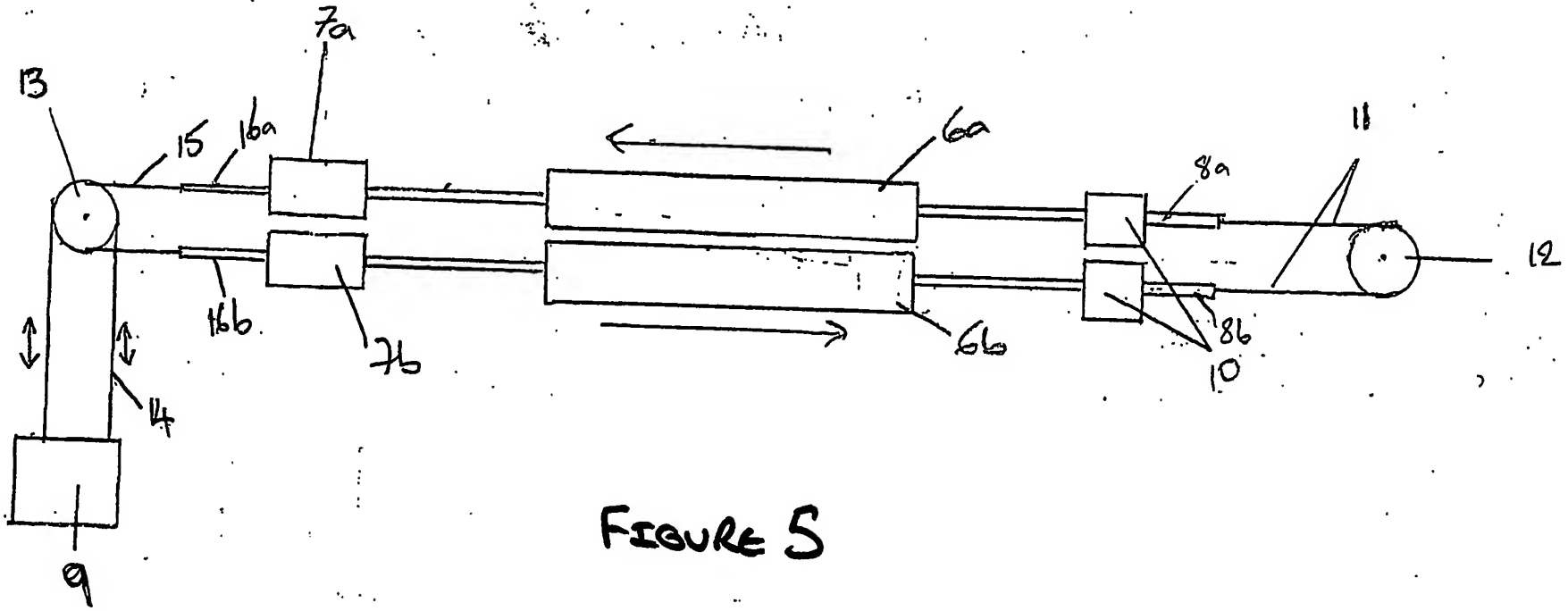

FIGURE 5